Adaptive SBRT for Liver and Pancreas Patients

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Pancreas & Liver Cancer

Incidence/epidemiology

- Relatively low incidence
- High mortality

Treatment with SBRT

- Apparent improved efficacy over standard fractionation
- Local control more important with improved systemic treatments
- More convenient and less disruptive to other treatments
- Move pancreas patient from borderline resectable to resectable or a liver patient to being a transplant candidate

![Estimated New Cases Chart]

![Estimated Deaths Chart]

Adapted from Seigel et al. 2021
Challenges of Liver and Pancreas SBRT

Radiosensitive organs at risk (OARs) close to target
Inter and intra-fractional tumor and OAR motion
Visibility of the tumor and OARs
Prescriptions (HyTEC)

Pancreas

36 Gy in 3 fractions (~43 Gy in 5)
- 1 year LC w/o surgery of 86%
- BED 79 Gy

24 Gy in 3 fractions (~28 Gy in 5)
- 1 year LC w/o surgery <70%
- BED 43 Gy

Liver

Primary liver
- No significant difference seen for BEDs 60-180 Gy

Liver metastases
- Significant improvement (93% vs 65% 3 year local control) with BED > 100 Gy (e.g. 50 Gy in 5)
Proximity of Organs at Risk

Stomach/duodenum/bowel constraints (5 fraction SBRT at MD Anderson)

Dmax < 40 Gy

V35 Gy < 1 cc

Adapted from Gunderson & Tepper, Clinical Radiation Oncology 5th ed.
Pancreatic Cancer Targets

Borderline resectable primarily concerned with vessels

- Limitation in surgery
- 90% of recurrences within ~2 cm of celiac axis and superior mesenteric artery (SMA)

Adapted from Toesca et al. 2018, Red Journal

Adapted from Dholakia et al. 2013, Red Journal
Proximity of Organs at Risk

GTV: Gross tumor volume
PTV: Planning target volume
PRV: Planning organ at risk volume
TVI: Tumor vessel interface

Large bowel
PTV + TVI 3 mm – GI PRV 3 mm
PTV
GTV
TVI
TVI 3 mm
GI PRV 3 mm
Duodenum
Small bowel

40 Gy
35 Gy
30 Gy
Interfractional motion

Causes
- Bowel/stomach filling
- Gas
- Patient setup

Problems
- Missed target
- OARs move into high dose region
- Difference in dose distribution

Solutions
- NPO/gas management
- High quality IGRT
- Adaptive planning
Interfractional Motion

Simulation CT
(original contours dotted lines)

Adaptive replan using daily CT
(new contours solid lines)
Intrafractional Motion

Causes
• Breathing

Problems
• Missed target
• Increased area of OAR irradiation

Solutions
• 4DCT
• Breath hold
• Compression
• Etc…
Tumor and OAR Visualization

CBCT image quality and artifacts

Free Breathing

Breath hold with fiducials
Goals of this Session

Understand the challenges associated with pancreas and liver SBRT and the role of high quality volumetric IGRT and adaptive planning in addressing them.

Josh Niedzielski
18 min + 2 min (Q&A): Importance of Daily Adaptation for the Management of Liver and Pancreas Patients Receiving SBRT

Kathryn Mittauer
18 min + 2 min (Q&A): MR Guidance and Online Adaptation of Liver and Pancreas Patients

10 min Q&A